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The impact of cross—section dependence on the capital mobility estimation

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ABSTRACT

Feldstein-Horioka model is one of the most famous puzzles in the international economics. The goal of this paper is to show that cross-section dependence among the countries plays important role in the estimation framework. We utilize Common Correlated Effects estimator which gives consistent estimates under the existence of cross-section dependence. We find that traditional assumption about I(1) process of dependent and the independent variable is misleading. Then we show the significant differences in the results between traditional fixed effect estimator and Common Correlated Effects estimator and so we give the next possible explanation to this puzzle.

Keywords: *Feldstein-Horioka, cross-section dependency, Common Correlated Effects.*

JEL codes**:** *E22, C33.*

1. INTRODUCTION

In 1980 Feldstein and Horioka (FH) introduce the model for the measure of capital mobility. The authors assume the following regression model

$$ir = \beta_0 + \beta_1 sr + u, \tag{1}$$

where $ir = \frac{I}{GDP}$ represents the national investments to GDP and $sr = \frac{S}{GDP}$ is national savings to GDP. Random term u is $iid(0, \sigma^2)$. In the case of perfect capital mobility the parameter β_1 has to be zero. With increasing of β_1 to the one, the capital mobility decrease. The theory behind this model comes from the neoclassical assumption that capital flow to the country with the highest rate of return. Under such assumption the country with a high rate of return will finance the domestic projects by the foreign investments.

The authors tested the equation 1 on the 16 OECD countries in the period 1960–1974. The estimated $\hat{\beta}_1$ was equal to 0.887. This result does not correspond to the expectation of high capital mobility. We can find a lot of papers trying to clarify this unexpected result which can be divided to the two groups -- economic theory, and econometric theory. In the economic theory group, we can find interesting articles, for example (Obstfeld and Taylor 1998), (Blanchard and Giavazzi 2002), (Taylor 2002). The econometrics group tries to find the key in the incorrect specification of regression model 1 or incorrect assumptions (Esso 2012), (Fattouh 2005), (Telatar et. al 2007).

In this article, we focus on the econometrics group and the assumption of the cross-section dependence. We show that the existence of the connections among the countries plays important role in the panel data model. We are not the first who analyze FH from this point of view. The cross-section dependency in the FH analyzed (Drakos et. al 2016). The authors tested the capital mobility in the 14 EU countries. The problematic part of their work is in the small number of cross-section units. They used Pesaran's estimator (Pesaran 2006)

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which is suggested for the minimal panel of 20 i × 20 t. In this work, we utilize imbalance panel with 153 cross-section unit and 45-time units and, as we respect the reccomendation of Pesaran´s work, we should get more relevant results. The second message of this work lies in the comparison of the panel data model with the assumption of the existence of cross-section dependency and the well known fixed effect model (FE).
The paper is organized as follows. In Methodology section, we describe the assumed data generation process of equation one and the proper panel estimator. Then in section Empirical part, we depict the cross section dependency test and regression results. The paper concludes in the section Conclusion.

2. METHODOLOGY

We assume the data generation process, represents by the following equations

$$ir_{it} = \beta_i sr_{it} + u_{it}, \tag{2a}$$

$$u_{it} = \alpha_{1t} + \boldsymbol{\lambda'_{1i} f_t} + \epsilon_{1it}, \tag{2b}$$

$$sr_{it} = \alpha_{2t} + \boldsymbol{\lambda'_{2i} f_t} + \epsilon_{2it}, \tag{2c}$$

Where $i = 1, \dots, N$, represents the cross-section dimension and $t = 1, \dots, T$, is time dimension. The regressor sr and error u contains the common variable f. This variable represents the common unknown factors. We test the existence of the common factors through the cross-sectional dependence test (Pesaran 2004). The test statistics has the following form

$$CD = \sqrt{\frac{2}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij}\,, \tag{3}$$

The $\hat{\rho}_{ij}$ is the estimate of the correlation coefficient between countries i and j from the residuals of the fixed effect model. The null hypothesis represents cross-section independency and CD statistic has an asymptotic standardized normal distribution.

If the H0 is rejected we can expect the data generation process describe by the equations (2a), (2b), (2c). In such case the most common models for panel data fixed effect or random effect give inconsistent estimates of β. Pesaran in 2006 suggested CCE-estimator (*Common Correlated Effects*), which leads to the consistent estimates for data generation process (2a), (2b), (2c). Pesaran approximates the unobserved factors f_t by the arithmetic means of the dependent and independent variables. In our case, the model has the following form

$$ir_{it} = \beta_i sr_{it} + \boldsymbol{\gamma'_i}\, \boldsymbol{\bar{z}_t} + e_{it}, \tag{4}$$

where $\boldsymbol{\bar{z}_t} = (\bar{sr}_t, \bar{ir}_t)$, $\bar{sr}_t = 1/N \sum_{i=1}^{N} sr_{it}$, $\bar{ir}_t = 1/N \sum_{i=1}^{N} ir_{it}$ and vector $\boldsymbol{\gamma_i}$ represents the additional regression parameters, $i = 1, \dots N$. Pesaran shows two versions of the CCE estimator, pooled (CCEP) and mean group (CCEMG). We work with the last one because we assume that the coefficient β_1 is different among the countries. So the β_{1i} is

$$\beta_{1i} = \beta_1 + \epsilon_i, \tag{5}$$

where β_1 is something like nature level and $\epsilon_i \sim iid(0, \sigma^2)$.

3. ANALYSIS AND RESULTS

We analyze 153 countries in the span of 1971 and 2016. In Table 1 we can see the cross-section dependency test from the equation 3. We can reject the null hypothesis on the level $\alpha = 0.01$ about cross-section independence.

The cross-section dependency influence the only the main equation but has an impact on the reliability of unit root tests, which could be misleading (Pesaran 2007). In this case, we have to use the second generation unit

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root tests which are robust to the cross-section dependency. We utilize the Pesaran unit root test (2007). We test version without drift and deterministic time trend and the second with the inclusion of drift. For both variables, we reject the null hypothesis about the existence of unit root on the level $\alpha = 0.01$. This result is in contrast with most of the papers, where ir and sr are I(1) processes.

In Table 2 are displayed the results from the CCEMG estimator in the first row and FE in the second row. The covariation matrices of estimates are robust to the heteroskedasticity and autocorrelation. In both cases, the parameter β_1 is statistically significant on the level $\alpha = 0.01$. We can not reject the H0 of the CD test for the residuals from the CCEMG estimator. On the other hand for the residuals from the FE, we can reject H0 from CD test on the level $\alpha = 0.01$. So in the case of CCEMG estimator, we annihilate the cross-section dependence. The most important result is the huge difference between estimates. The FE estimator indicates very low β_1, therefore very high global capital mobility. On the other hand, the model which assumes the cross-section dependence indicates lower global capital mobility.

Table 1. Cross-section dependency test

Variable	CD-test	p-value	corr
ir	27.84	0.000	0.043
sr	22.12	0.000	0.037

Table 2. CCEMG and FE results

Variable	Coef.	Std.Err.	z-value	p-value
sr_{CCEMG}	0.2925	0.0307	9.51	0.000
sr_{FE}	0.0697	0.0087	7.96	0.000

4. CONCLUSIONS

We analyze the famous equation from Feldstein and Horioka in case of existence cross-section dependency among the countries. We show that the countries are connected and in such case, the traditional panel techniques are misleading. Another very interesting result is provided by the unit root test. We reject the hypothesis about unit roots which is in conflict with the majority of the papers on this subject. This unexpected result could be caused by of the higher power of the test for panel data unit root test. We estimated the FH equation by the CCEMG and FE estimator and we found that controlling the cross-section dependency has a significant effect on the parameter estimates. So one of the possibilities of FH puzzle explanation could have roots in the omission of the mutual connection among countries.

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